PARSONS BRINCKERHOFF

Quincy Center Intermodal Station Benefit-Cost Analysis

Prepared for the City of Quincy

Date: June 5, 2015

Contents

Executive Summary

A benefit-cost analysis (BCA) was conducted for the Quincy Center Intermodal Station for submission to the U.S. Department of Transportation (U.S. DOT) as a requirement of a discretionary grant application for the TIGER VI program. The analysis was conducted in accordance with the benefit-cost methodology as recommended by the U.S. DOT in the Federal Register (79 FR 11854) and conducted for a 30-year analysis period after operations begin in 2019.

The analysis shows a benefit-cost ratio that exceeds 1.0, meaning the project returns economic benefits that exceed project costs over the life of the investment. In the case of the Quincy Center Intermodal Station, the project will also generate significant economic development impacts for the City and region, particularly its ability to stimulate further downtown redevelopment and to make public sector services operate much more efficiently. These benefits are difficult to forecast, and have been incorporated into the BCA to some degree, but very conservative assumptions have been made about the project's overall ability to help reinforce downtown regeneration. It is likely that the potential overall economic benefits have been only partly captured by the BCA.

The Quincy Center Intermodal Station is a critical element of the City's vision to redevelop and revitalize Quincy Center by creating a gateway that enhances connections from Quincy to the MBTA network of greater Boston, and making Quincy more accessible to the surrounding areas and the State, as well as tourists from within and outside Massachusetts. The original MBTA station, which opened to MBTA Red Line passenger service in 1971, includes an 863-space parking structure (condemned in 2012) above the Red Line and commuter rail tracks. This station is already used by more than 7,000 people daily.

The project will provide a new bus station, renovate the rail station, and creates air development rights over the station, which would allow for the development of Transit Oriented Development (TOD). The TOD comprises the proposed new Regional Justice Center, office space and Adams National Park Service (NPS) Visitor Center will be an important destination in itself further enhancing the experience of those who work in, live in, or visit Quincy.

A series of improvements will be made to create new air development rights, reduce travel time for riders, and create a more convenient and welcoming pedestrian and passenger access and egress from the Quincy Center station, including:

- Developed on air rights above the station, this TOD provides an unmatched opportunity to create new civic and private development in the heart of the City, bringing thousands of new jobs.
- The project will rebuild the MBTA station that serves Red Line Subway, Old Colony Commuter Rail, and 15 bus routes that converge on Quincy Center, carrying over 14,500 passengers every weekday or 29,000 trips. The redesign will transform the outdated station into a true intermodal center, facilitating access for transit riders, pedestrians, and bicyclists while simultaneously updating electrical/mechanical systems, life safety systems, and security systems.
- At the same time, the project will foster the development of the TOD, such as the proposed new Regional Justice Center, 100,000 SF of new office space and a National Park Service Adams

National Park Visitor Center that will become an important destination in itself, further enhancing the experience of those who work in, live in, or visit Quincy.

When built, the project will provide many benefits to passengers of buses, the Red Line, and commuter rail, pedestrians, bicyclists, and for the efforts to redevelop Quincy Center. The project overall furthers the redevelopment of Quincy Center, a major ongoing urban development initiative which takes full advantage of the historical significance of Quincy and its rich heritage of historical attractions. The following quantifiable benefits have been included in this Benefit Cost Analysis:

- Economic competitiveness
    - Travel time savings and reduction of delays for users of MBTA bus routes into and out of Quincy Center Station.
    - Travel time savings and faster access into and out of the train station for users of MBTA Red Line and commuter rail
- Sustainability/mobility
    - Improved amenities for passengers and other people using the Quincy Center station
- Safety
    - Improved safety and reduced accidents for pedestrians in and around the bus station
- Energy
    - Reduced energy costs in the operations and maintenance of the station
- Livability
    - The creation of air development rights over the station and tracks (after the removal of the structurally deficient parking garage), which will allow for major development such as the proposed implementation of a new Regional Justice Center and an office complex, which is planned to incorporate a new Adams National Park Visitors' Center.
    - Support of the overall redevelopment of Quincy Center, playing a role in the Urban Revitalization and Development Plan and increasing property values.

There were two alternative computations conducted for this analysis, using a 7.0 percent discount rate, and an alternative using a 3.0 percent discount rate, as prescribed by the U.S. DOT. For the 7 percent discount rate, the proposed infrastructure investments yield a net present value of $15.7 million, and a benefit-cost ratio of 1.38. At a 3 percent discount rate, the proposed infrastructure investments yield a net present value of $37.1 million, and a benefit- cost ratio of 1.79.

Table ES-1 presents the evaluation results for the two cases. All benefits and costs were estimated in constant 2014 dollars over an operating evaluation period extending 30 years. The base year for discounting is 2015 but economic values (e.g., the values of time, emissions savings, VOCs, project costs, etc) are in 2014 dollars, as full year data for 2015 are not available, and forecasting to 2015 was considered uncertain.

Table ES-1 Benefit Cost Analysis Summary Results

Scenario	Net Present Value (2014 $ millions disc.)	Benefit Cost Ratio
Case A (7 percent discount rate)	**$15.7**	**1.38**
Case B (3 percent discount rate)	**$37.1**	**1.79**

Benefits by Category

Benefits have been estimated in the categories listed below. The estimated values have been entered into Parsons Brinckerhoff's PRISM model, which has been used successfully for many previous TIGER grant applications. The PRISM model is used to estimate benefit and cost streams over time, and for discounting to present value to arrive at the benefit-cost ratio.

The table below outlines the changes in some of the categories of benefits that were included in the analysis of the Quincy Center MBTA and Intermodal Facility over the entire 30-year analysis period.

TABLE ES-2 Project Impacts for Quincy Center Intermodal Station, Cumulative 2017-2048

Category	Quantity
Reduced bus passenger hours of delay (PHD)	180,500 ▼
Reduced rail passenger/customer passenger hours of delay for access into and out of the train station (PHD)	2.02 million▼
Improved amenities in the station (value)	$13,5 million ▲
Safety improvements – reduced deaths (fatalities)	3 ▼
Safety improvements – reduced accidents (injuries)	3 ▼
Reduced energy costs ($)	$165,500 ▼
Creation of air development rights ($ value)	$26.5 million▲
Increase in economic/property values ($)	$18.7 million▲

Source: Parsons Brinckerhoff, 2015

Over the 30-year analysis period, there are $57.0 million in benefits at a 7% discount rate, in 2014 dollars and $84.2 million in benefits I at a 3% discount rate in 2014 dollars.

Costs over Time

Costs used in the benefit cost analysis include capital construction; and annual operations and maintenance costs. Capital investments ($52.1 million) were assumed to begin in 2017 and conclude by the end of 2018. These capital costs translate to $41.3 million when discounted at 7 percent and $47.1 million when discounted at 3 percent.

Introduction

A benefit-cost analysis (BCA) was conducted for the Quincy Center Intermodal Station for submission to the U.S. Department of Transportation (U.S. DOT) as a requirement of a discretionary grant application for the TIGER VII program. The analysis was conducted in accordance with the benefit-cost methodology as recommended by the U.S. DOT in the Guide to Preparing Benefit-Cost Analyses for TIGER Grants[1] and the Notice of Funding Availability (80 FR 18283).

Analytical Assumptions

Discount Rates

For project investments, dollar figures in this analysis are expressed in constant 2014 dollars. In instances where certain cost estimates or benefit valuations were expressed in dollar values in other (historical) years, the U.S. Bureau of Labor Statistics' Consumer Price Index for Urban Consumers (CPI-U) was used to adjust them.[2]

The real discount rates used for this analysis were 3.0 and 7.0 percent, consistent with U.S. DOT guidance for TIGER VI grants[3] and OMB Circular A-4.[4].

Evaluation Period

For the Quincy Center Intermodal Station, the evaluation period includes the relevant (post-design) construction period during which capital expenditures are undertaken, plus 30 years of operations beyond the Project completion within which to accrue benefits.

For the purposes of this study, it has been assumed that the demolition of the existing garage will begin as early as 2016 (in a separate phase before this TIGER project begins), and larger construction for this project will start in 2017. The construction period continues through 2018, and operations will begin in 2019. The analysis period, therefore, begins with the project's first expenditures in 2017 and continues through 30 years of operations, or through 2048.

All benefits and costs are assumed to occur at the end of each year, and benefits begin in the calendar year immediately following the final construction year.[5]

---

[1] TIGER 2015 NOFA: Benefit-Cost Analysis Guidance, Updated March 27, 2015; http://www.dot.gov/tiger/guidance

[2] U.S. Bureau of Labor Statistics. Consumer Price Index, All Urban Consumers, U.S. City Average, Series CUSR0000SA0. 1982-1984=100

[3] TIGER 2015 NOFA: Benefit-Cost Analysis Guidance, Updated March 27, 2015; http://www.dot.gov/tiger/guidance

[4] White House Office of Management and Budget, Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (October 29, 1992). (http://www.whitehouse.gov/omb/circulars_a094).

(Note that in the benefit cost model, 2015 is the first year of the analysis (year zero) and all values are discounted to that year. Present value is calculated with respect to 2015. Unit costs and benefit factors are in 2014 dollars, because 2015 is not complete and unit values are not yet available for 2015.)

Annualizing Factor Assumptions

Data about passenger ridership on transit and pedestrian walking statistics are sometimes provided in terms of daily or average weekday volumes. For roadway vehicular volumes, travel demand models produce outputs on daily or sub-daily basis. An annualization factor is thus necessary to convert the travel demand outputs into to yearly values. Based on data from MBTA[6], this project used the following annualization factors to convert from average weekday volumes to annual volumes:

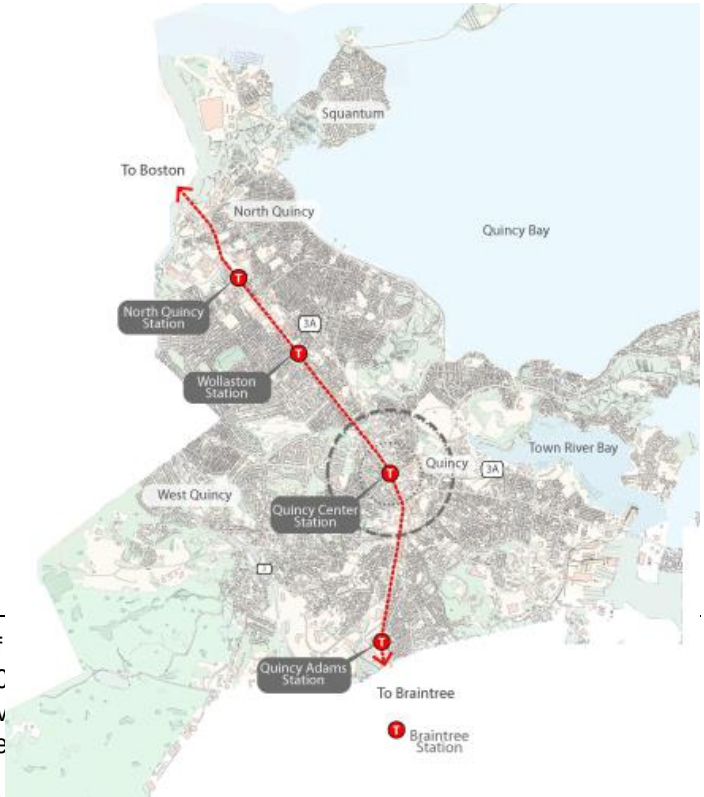
- Red Line, 309
- All commuter rail, 274

Project Region and Current Transportation Inefficiencies

Quincy Center Station is located in the heart of Quincy Center 10.4 miles south of Boston. The Station is immediately adjacent to Quincy Center's commercial district on Hancock Street. Quincy Center Station is a vital transportation hub integrating MBTA bus, commuter rail and Red Line subway service and connecting Quincy Center to the MBTA metro-Boston transit network.

MBTA Red Line Subway

The MBTA's Red Line subway provides access from Quincy Center to downtown Boston in 20 minutes and Cambridge in 30 minutes, on frequent (8-10 minute peak period) headways. This branch of the MBTA Red Line, which extends from Alewife station in Cambridge to the north to Braintree to the south, connects to service on the Green/Blue/Orange/Silver Lines for travel to and from other regional centers of employment. South Station on the Red Line also accommodates connections to Amtrak



[5] In the benefit cost model, 2015 is the first year of
year. Present value is calculated with respect to 20
2015 is not complete and unit values are not yet av
[6] MBTA Ridership and Service Statistics (2014 "Blue

Service and additional commuter rail service.

MBTA Old Colony Line Commuter Rail

Of four subway stations serving Quincy, only Quincy Center Station provides commuter rail service. High volumes of commuter rail service on the Old Colony Line limits additional service. The Old Colony Commuter Rail provides service between South Station in Boston on three branch lines to terminals at Greenbush, Kingston/Plymouth, and Middleborough. The Old Colony provides service to 20 communities south of Boston covering a service area with a total 2010 Census population of 447,385.

MBTA Bus Station

Quincy Center Station is also the largest bus hub south of Boston and provides service on 15 routes to communities in the Quincy area. The existing busways are located on the east side of the station off Hancock Street and at the curb on the west side off Burgin Parkway. However, buses dropping off passengers who have accessibility requirements on Burgin Street must drive around to the Hancock Street side since the Burgin Street entry lacks an accessible entry.

PRISM™

This benefit cost analysis was done using PRISM™, a benefit cost analysis tool that uses a methodology consistent with the most recent guidelines developed by USDOT. The tool determined benefits according to the following five categories: State of Good Repair; Economic Competitiveness; Livability; Sustainability; and Safety. Economic values in PRISM have been update to reflect current TIGER guidelines, as well as current information and research.

Economic Benefits Included

The following identifies and groups the benefits that are included in the BCA for the Quincy Center Intermodal Station project. While this section discusses the valuations used for each benefit category specifically, a model output summary of all valuations as used in PRISM™ sensitivity analysis, with statistical details, are available in Appendix C.

When built, the project will provide many benefits to passengers of buses, the Red Line, and commuter rail, pedestrians, bicyclists, and for the efforts to redevelop Quincy Center. The project overall furthers the redevelopment of Quincy Center, a major ongoing urban development initiative which takes full advantage of the historical significance of Quincy and its rich heritage of historical attractions. The following broad categories and quantifiable benefits have been included in this Benefit Cost Analysis:

- Economic competitiveness
    - Travel time savings and reduction of delays for users of MBTA bus routes into and out of Quincy Center Station.
    - Travel time savings and faster access into and out of the train station for users of MBTA Red Line and commuter rail

- Sustainability/mobility
    - Improved amenities for passengers and other people using the Quincy Center station
- Safety
    - Improved safety and reduced accidents for pedestrians in and around the bus station
- Energy
    - Reduced energy costs in the operations and maintenance of the station
- Livability
    - The creation of air development rights over the station and tracks (after the removal of the structurally deficient parking garage), which will allow for major development such as the proposed implementation of a new Regional Justice Center and an office complex, which is planned to incorporate a new Adams National Park Visitors' Center.
    - Support of the overall redevelopment of Quincy Center, playing a role in the Urban Revitalization and Development Plan and increasing property values

Economic Competitiveness

Travel Time Savings or Reduction of Delays for Travelers

On many project analyses, travel time savings for benefit cost analysis typically include in-vehicle travel time savings for auto drivers and passengers as well as truck drivers. In this project, the creation of a new dedicated bus terminal will provide a reduction in delays for bus passengers. The improvement in access to the rail station will provide travel time savings for rail passengers, pedestrians, cyclists, and bus riders arriving or leaving the train station. Travel time is considered a cost to users, and its value depends on the disutility that travelers attribute to time spent traveling. A reduction in travel time translates into more time available for work, leisure, or other activities.

Reduction in Delays for MBTA bus riders

For the benefit-cost analysis using the PRISM model, data was gathered from MBTA about routes to and from Quincy Center[7] and the numbers of passengers alighting from those routes[8]. Information about the expected reduction in delays for the bus passengers was gathered from the design consultants who are coordinating the project[9]. Based on observations of bus movements at the current Quincy Center bus station, there are various factors that currently cause delays for arriving or departing buses. For example, some buses cannot reach their assigned berths upon arrival at the station because taxis or vans may be blocking their path to the berths, or other preceding buses are blocking the access lane to the berths, or other buses are still in their assigned berth. The new bus station layout will provide more berths and will provide a more efficient path for accessing the berths.

For the purposes of the benefit cost analysis, it was assumed that there would be an average reduction of delays of about 15 seconds for arriving and departing buses. Together with bus data from MBTA, this translates to an annual reduction of about 6,000 passenger hours of delays for the bus passengers.

[7] Source: MBTA Ridership and Service Statistics (2014 Blue Book)
[8] Source: MBTA 2012 Ridership Counts.
[9] Source: Parsons Brinckerhoff, May 2015.

Reduction in Access Time and Delays for MBTA Red Line and Commuter Rail Passengers

For the benefit-cost analysis using the PRISM model, data was gathered from MBTA about Red Line and Commuter routes to and from Quincy Center station10 and the numbers of passengers entering the Red Line station or boarding commuter rail. Information about the expected reduction in access time for the rail passengers entering or leaving the station was gathered from the design consultants who are coordinating the project. Based on proposed improvements in access points to the station, access compliant with Americans with Disabilities Act, and other improvements for pedestrians in and around the station, it was assumed that rail passengers would reduce their average walking and waiting time by more than one minute. Together with MBTA rail ridership data, this translates to an annual reduction of 67,500 passenger hours of delays for the rail passengers.

Value of Time Assumptions

Travel time savings must be converted from hours to dollars in order for benefits to be aggregated and compared against costs. This is performed by assuming that travel time is valued as a percentage of the average wage rate, with different percentages assigned to different trip purposes (Table 1).

Values are broken down as low, medium and high for use in the PRISM™ analysis based on the percentages in Table 1, as recommended by U.S. DOT. [11]

Table 1. U.S. DOT Recommended Values of Time, 2014; (per person-hour as a percentage of total earnings)

Category	Surface Modes (Except High-Speed Rail) Low	Likely	High
Local Travel			
Personal	35%	50%	60%
Business	80%	100%	120%
Intercity Travel			
Personal	60%	70%	90%
Business	80%	100%	120%
Vehicle Operators			
All	80%	100%	120%

Source: Office of the Secretary of Transportation, 2014.

The analysis takes information from the US DOT recommended values of time, using the data from the "likely" column in Table 2. Values of time used for 2015 are as follows:

Table 2. U.S. DOT Recommended Values of Time, 2014 $

[10] Source: MBTA Ridership and Service Statistics (2014 Blue Book)

[11] Office of the Secretary of Transportation. (2014). *Revised Departmental Guidance: Valuation of Travel Time in Economic Analysis,* p. 11-12. (http://www.dot.gov/sites/dot.gov/files/docs/USDOT%20VOT%20Guidance_0.pdf)

Category	Values of time (2014 U.S $ per person-hour) Low	Values of time (2014 U.S $ per person-hour) Likely	Values of time (2014 U.S $ per person-hour) High
Surface (except High-Speed Rail)			
Local Travel			
Personal	$10.16	$12.70	$15.24
Business	$19.84	$24.80	$29.76
All Purposes	$10.61	$13.26	$15.91
Intercity Travel			
Personal	$14.22	$17.78	$21.34
Business	$19.84	$24.80	$29.76
All Purposes	$15.43	$19.28	$23.14
Air and High-Speed Rail			
Intercity Travel			
Personal	$26.99	$33.74	$40.49
Business	$49.34	$61.68	$74.02
All Purposes	$36.02	$45.03	$54.03
Other			
Truck Drivers	$20.98	$26.22	$31.46
Bus Drivers	$21.70	$27.13	$32.56
Transit Rail Operators	$37.64	$47.05	$56.46
Locomotive Engineers	$31.46	$39.33	$47.20
Airline Pilots and Engineers	$68.46	$85.57	$102.68

Source: Office of the Secretary of Transportation, 2015.

Because the exact division between personal and business travel is not known for trips potentially impacted by this project, the values of time for "all purposes" are used; these represent a weighted average of the personal and business values of time according to national proportions of personal and business as calculated by the U.S. DOT.[12]

Additionally, U.S. DOT guidance accepts the use of a real growth rate of 1.2 percent a year for the value of time.[13]

[12] Ibid.

[13] Office of the Secretary of Transportation. (2014). *Revised Departmental Guidance: Valuation of Travel Time in Economic Analysis (Revision 2)*, p. 14. (http://www.dot.gov/sites/dot.gov/files/docs/USDOT%20VOT%20Guidance%202014.pdf)

Safety

Accident Cost Savings

The cost savings that arise from a reduction in the number of accidents include direct savings (e.g., reduced personal medical expenses, lost wages, and lower individual insurance premiums), as well as significant avoided costs to society (e.g., second party medical and litigation fees, emergency response costs, incident congestion costs, and litigation costs). The value of all such benefits – both direct and societal – could also be approximated by the cost of service disruptions to other travelers, emergency response costs to the region, medical costs, litigation costs, vehicle damages, and economic productivity loss due to workers' inactivity.

The Quincy Center bus station is known to have safety concerns because of the way that pedestrians commonly pass through the bus loading zone, walking close to and between arriving and departing buses.

Accident data for 10 years (2005-2015) in and around the bus station were provided by the Quincy Police Department. They provided accident information for streets or intersections near the station, especially those near pedestrian access points[14]. A brief search of internet news reports also uncovered one (1) fatal pedestrian accident with buses in and around the station, and one (1) serious injury of a pedestrian by a bus. Based on this information, an accident rate was conservatively assumed for the PRISM model.

The new bus facility will be laid out to reduce the frequency of pedestrians walking through the bus loading and unloading zone. For the purposes of the benefit-cost analysis, it was assumed that this would result in a reduction in accidents.

[14] City of Quincy, J Pepjanovich, May 19, 2015. Police Department accident information from 2005-2015 for streets or intersections near the station, especially those near pedestrian access points: Dimmock Street; Burgin Parkway and Granite Street; Washington Street and Hancock Street.

Sustainability/Mobility

Energy Savings

The train station will be designed with a higher degree of energy efficiency. Information about the expected reduction in energy costs for lighting, electrical, and HVAC in the station was gathered from the design consultants who are coordinating the project[15]. Because of expected efficiencies and modern equipment, it was assumed that energy costs for the Quincy Station would reduce by over $5500/year.

Livability

The Quincy Center Intermodal Station is a critical element of the City's vision to redevelop and revitalize Quincy Center by creating a gateway that enhances connections from Quincy to the MBTA network of greater Boston. The project will play a major role in the Urban Revitalization and Development Plan by strengthening the transportation hub and creating development air rights above the station and train tracks, which are a prime location for transit oriented development. This will allow for major development such as the proposed implementation of a new Regional Justice Center and an office complex, which is planned to incorporate a new Adams National Park Visitors' Center. This development activity will serve to further spur and foster the vitality of Quincy's Urban Revitalization and Development Plan, raising economic and property values.

Air Development Rights

After the existing structurally deficient parking garage is removed, the Quincy Center Intermodal Station project will build the transit station and the bus station. With the planned new bus station and renovated transit station in place, the development above the station and train tracks can take place. The creation of air development rights over the station and tracks will allow for major development to occur such as the proposed implementation of a new Regional Justice Center and an office complex.

This benefit cost analysis includes the value of the air development rights over the station and tracks. From a developer's perspective, buying air rights are akin to buying land to develop on, or in this case to develop above the station and tracks. The value of air rights is normally valued at less than similar land values in the same vicinity due to factors such as the additional costs required to build on top of an existing structure as opposed to on the ground.

For estimating the economic value of air development rights in the benefit cost analysis, a number of different pieces of information were gathered/compiled from a variety of sources, including:

- The size of the proposed courthouse facility: 325,000 gross square feet, GSF
- The size of the proposed office building: 150,000 GSF

[15] Source: Parsons Brinckerhoff, A Federico, Principal Systems and Communications Engineer, May 2015.

- The expected size of a development if courthouse site is built to zoning max of 10 stories: 465,000 GSF
- The expected size of a development if office site is built to zoning max of 10 stories: 250,000 GSF
- The expected size of additional development if a larger footprint is taken over the tracks: 225,000 GSF
- Total additional air rights if sites are built to maximum size: 940,000 GSF
- Value of premier site, provided by a real estate consultant firm[16] that works with the City of Quincy, approximately $25/SF.

Value of Increased Amenities

The redevelopment of the existing MBTA and bus station facilities will provide many new and/or improved services. These additions and improvements will have a significant impact in several areas. In terms of livability, they provide a measurable benefit to the consumers of public transportation, as well as the public at large.

In addition, the amenities provide economic value to passengers, which can be quantified. The total economic value of these benefits can be measured as the sum of benefits to passengers expected to utilize the Quincy Center station under a baseline ridership assumption as well as an assumed additional ridership that would be attracted to transit routes serving Quincy Center as a result of the increased station amenities and services.

Research based largely on stated preference surveys has provided a basis for monetizing these amenity benefits. According to the Victoria Transport Policy Institute (VTPI), "travelers place a high value on qualitative factors such as convenience, comfort, security and prestige."[17] The VTPI has reported these findings from research detailing what the average traveler would be willing to pay for such improvements. The following table contains this information.

Table 3

Categories - Value of Station Improvements	US Cents	Percent
Tickets	$0.023	1.9%
Cleaning	$0.018	1.5%
Station Building	$0.014	1.1%
Staff	$0.013	1.0%
Ease of Train On & Off	$0.011	0.8%

[16] Source: Memorandum about "Quincy Center Office Pricing Indicators," RKG Associates, Economic Planning and Real Estate Consultants, F Pulitzer, May 22, 2015

[17] *www.vtpi.org/quality.pdf*

Platform Surface*	$0.010	0.8%
Station Announcements	$0.008	0.6%
Safety	$0.008	0.6%
Signing	$0.007	0.5%
Graffiti	$0.007	0.5%
Retail	$0.007	0.5%
Platform Seating	$0.006	0.5%
Lifts/Escalators*	$0.004	0.3%
Information	$0.004	0.3%
Station Lighting	$0.004	0.3%
Bus	$0.003	0.2%
Bike	$0.003	0.2%
Toilets	$0.002	0.2%
Parking Lot	$0.002	0.2%
Parking Lot Drop-Off	$0.002	0.2%
Platform Weather Protection	$0.001	0.1%
Subway/Over-bridge*	$0.001	0.1%
Taxi	$0.001	0.1%
Telephone	$0.001	0.1%

Adapted from Douglas Economics 2006 [18]

Many studies conducted over a lengthy period of time have empirically demonstrated that average elasticities of transit ridership with respect to transit fares hover in the area of -0.3, referring to this

[18] Douglas Economics (2006), Value and Demand Effect of Rail Service Attributes, RailCorp.

value as the "Simpson-Curtin Rule," based on early studies by researchers bearing those names.[19] The Simpson-Curtin Rule states that for every one percent increase in fares, there is a corresponding 0.33 percent decrease in ridership; for every one percent decrease in fares, there is a 0.33 percent increase in ridership.

More current research suggests that the increase and decrease in ridership is closer to 0.40 percent. According to VTPI research compilations, the elasticity of transit ridership with respect to fares is about 0.3 to 0.5 in the short run (first year) and increases to about 0.6 to 0.9 percent over the long run (five to ten years).[20] Other studies have substantiated this research.[21]

Therefore, 0.40 percent has been used as the elasticity ratio in this study. Elasticities are referred to as shrinkage ratios, as they do not vary with the size or direction of the fare increase or the initial level of the fare.[22]

Economic Costs Included and Assumptions

In the benefit-cost analysis, the term "cost" refers to the additional resource costs or expenditures required to implement, and maintain the investments associated with the Quincy Center Intermodal Station project.

The BCA uses project costs that have been estimated for the project on an annual basis. Operations and maintenance costs and rehabilitation costs were initially expressed in real dollars while the capital costs were initially expressed in real 2015 dollars. All costs were converted to real 2014 dollars based on CPI-U adjustments.[23]

Initial Project Investment Costs

Initial project investment costs include engineering and design, construction, real estate services, vehicles, other capital investments, and contingency factors. These costs were gathered from a "Quincy Center Air Rights Development" analysis[24], and included costs proposed to begin in 2017 and end in 2018. The facility is expected to be operational in 2019.

The capital expenditures on the rail station and the bus station will be a total of $52 million, divided between 2017 and 2018.

---

[19] http://www.apta.com/resources/reportsandpublications/Documents/Pham_Linsalata_Fare_Elasticity_1991.pdf
[20] http://www.vtpi.org/tranelas.pdf
[21] Joyce Dargay, Mark Hanly, G. Bresson, M. Boulahbal, J.L. Madre and A. Pirotte (2002), The Main Determinants of the Demand for Public Transit: A Comparative Analysis of Great Britain and France, ESRC Transport Studies Unit, University College London. Peter Nijkamp and Gerard Pepping (1998), "Meta-Analysis for Explaining the Variance in Public Transport Demand Elasticities in Europe," Journal of Transportation Statistics, Vol. 1, No. 1, Jan., pp.1-14.

[22] http://www.vtpi.org/quality
[23] Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, U.S. City Average, All Items, Series CUSR0000SA0.
[24] "MassDOT Quincy Center Air Rights Development Order of Magnitude Estimate," Scheme E, Designers, Parsons Brinckerhoff, Arrowstreet; cost estimate prepared by Parsons Brinckerhoff, April 28, 2015, updated May 21, 2015.

Note that outlays spent for the acquisition of real estate or real assets (right of way) are generally excluded from total costs in BCAs. This is because when the government acquires a real asset, it is classified as an asset purchase and not a cost. The owning agency would be in possession of tangible assets that, generally, does not depreciate in value. Thus, the costs of right of way and other property costs are excluded from this analysis.

Annual Operating and Maintenance Costs

The annual costs of operating and maintaining the proposed Quincy Center Intermodal Station are included in the analysis. For the purposes of this benefit cost analysis, operations and maintenance (O&M) activities apply to the parking garage and associated ramps, special parking for the proposed court facilities, the bus station, and the MBTA Red Line and commuter rail station. Operating and maintenance costs are assumed to begin in 2019, which is year one of the Project.

The O&M costs reported are the marginal operating costs, or the costs above and beyond those expected in the "no build" scenario, without the new parking garage and intermodal station facility.

Residual Value

Buildings can be assigned a wide range of lifespans. A lifespan that is often quoted for buildings is in the range of 60 years. For the purposes of this benefit-cost analysis, it has been assumed that the lifespan of a station building is about 60 years.

The new Quincy Center Intermodal Station project is expected to be completed in 2018. It is assumed to have a 60-year life cycle, until 2077, after which point the facility will be in need of replacement and rehabilitation. This BC however ends in 2048; – therefore at the end of the analysis period, infrastructure that has been put in place will not have been completely worn out, and will continue to provide benefits into the future. These future benefits are captured in the Residual value, also known referred to as "Remaining Capital Value," or RCV. In this analysis the RCV is calculated using a straight line depreciation method.

Key Benefit-Cost Evaluation Measures

The benefit-cost analysis converts potential gains (benefits) and losses (costs) from the Project into monetary units and compares them. The following two (2) common benefit-cost evaluation measures are included in this BCA.

Net Present Value (NPV): NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.

Benefit Cost (B/C) Ratio: The evaluation also estimates the benefit-cost ratio; the present value of incremental benefits is divided by the present value of incremental costs to yield the benefit-cost ratio. The B/C ratio expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of their associated costs.

There were two alternative computations conducted for this analysis, using a 7.0 percent discount rate, and an alternative using a 3.0 percent discount rate, as prescribed by the U.S. DOT. For the 7 percent discount rate, the proposed infrastructure investments yield a net present value of $15.7 million, and a benefit-cost ratio of 1.38. At a 3 percent discount rate, the proposed infrastructure investments yield a net present value of $37.1 million, and a benefit- cost ratio of 1.79.

Table 4 presents the evaluation results for the two cases. All benefits and costs were estimated in constant 2014 dollars over an operating evaluation period extending 30 years. The base year for discounting is 2015 but economic values (e.g., the values of time, emissions savings, VOCs, project costs, etc) are in 2014 dollars, as full year data for 2015 are not available, and forecasting to 2015 was considered uncertain.

Table 4 Benefit Cost Analysis Summary Results

Scenario	Net Present Value (2014 $ millions disc.)	Benefit Cost Ratio
Case A (7 percent discount rate)	**$15.7**	**1.38**
Case B (3 percent discount rate)	**$37.1**	**1.79**

Benefits by Category

Benefits have been estimated in the categories listed below. The estimated values have been entered into Parsons Brinckerhoff's PRISM model, which has been used successfully for many previous TIGER grant applications. The PRISM model is used to estimate benefit and cost streams over time, and for discounting to present value to arrive at the benefit-cost ratio.

The table below outlines the changes in some of the categories of benefits that were included in the analysis of the Quincy Center MBTA and Intermodal Facility over the entire 30-year analysis period.

TABLE 5 Project Impacts for Quincy Center Intermodal Station, Cumulative 2017-2048

Category	Quantity
Reduced bus passenger hours of delay (PHD)	180,500 ▼
Reduced rail passenger/customer passenger hours of delay for access into and out of the train station (PHD)	2.02 million▼
Improved amenities in the station (value)	$13,5 million ▲
Safety improvements – reduced deaths (fatalities)	3 ▼
Safety improvements – reduced accidents (injuries)	3 ▼
Reduced energy costs ($)	$165,500 ▼
Creation of air development rights ($ value)	$26.5 million▲
Increase in economic/property values ($)	$18.7 million▲

Source: Parsons Brinckerhoff, 2015

Over the 30-year analysis period, there are $57.0 million in benefits at a 7% discount rate, in 2014 dollars and $84.2 million in benefits I at a 3% discount rate in 2014 dollars.

Costs over Time

Costs used in the benefit cost analysis include capital construction; and annual operations and maintenance costs. Capital investments ($52.1 million) were assumed to begin in 2017 and conclude by the end of 2018. These capital costs translate to $41.3 million when discounted at 7 percent and $47.1 million when discounted at 3 percent.

APPENDIX A—Benefit-Cost Model Detail Tables

TIGER

Table A-1. Detailed Input Parameters for Quincy Center Intermodal Station Benefit Cost Model (Years 2017—2048)

		Calender Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Forecast period flag		Factor	1	1	1	1	1	1	1	1	1	1
Variable	**Source/Notes**	**Unit**										
Travel Time Savings - Bus Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	-	-	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016
Travel Time Savings - Intercity Rail Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	-	-	595	595	595	595	595	595	595	595
Travel Time Savings - Rail Transit Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	-	-	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869
Safety - Fatality	negative = increase in accidents, positive = decrease in accidents	incidents	-	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Safety - MAIS 3	negative = increase in accidents, positive = decrease in accidents	incidents	-	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Reduced Energy Use	negative = increase in energy cost, positive = decrease in energy cost	$	-	-	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520
Commuter Mobility Ben-Station improvemts	negative = decrease in Liveability, positive = increase in Liveability	$	-	-	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520
Increase in QC property values	negative = decrease in property values, positive = increase in QC property values	$	-	-	18,710,794	-	-	-	-	-	-	-
Air Rights Dev - Livability	negative = decrease in real est value, positive = increase in air right value	$	-	-	26,521,008	-	-	-	-	-	-	-
Residual Value	negative = residual value cost offset, positive = n/a	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs	negative = cost savings (n/a), positive = cost of project	2014 $	28,938,241	23,188,241	-	-	-	-	-	-	-	-

Note: Input data for PRISM benefit cost model

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Table A-1. Detailed Input Parameters for Quincy Center Intermodal Station Benefit Cost Model (Years 2017 – 2048)

Variable	Source/Notes	Unit	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Forecast period flag		Calender Year	1	1	1	1	1	1	1	1	1	1
		Factor										
Travel Time Savings - Bus Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016
Travel Time Savings - Intercity Rail Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	595	595	595	595	595	595	595	595	595	595
Travel Time Savings - Rail Transit Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869
Safety - Fatality	negative = increase in accidents, positive = decrease in accidents	incidents	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Safety - MAIS 3	negative = increase in accidents, positive = decrease in accidents	incidents	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Reduced Energy Use	negative = increase in energy cost, positive = decrease in energy cost	$	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520
Commuter Mobility Ben-Station improvemts	negative = decrease in Liveability, positive = increase in Liveability	$	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520
Increase in QC property values	negative = decrease in property values, positive = increase in QC property values	$	-	-	-	-	-	-	-	-	-	-
Air Rights Dev - Livability	negative = decrease in real est value, positive = increase in air right value	$	-	-	-	-	-	-	-	-	-	-
Residual Value	negative = residual value cost offset, positive = n/a	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs	negative = cost savings (n/a), positive = cost of project	2014 $	-	-	-	-	-	-	-	-	-	-

Note: Input data for PRISM benefit cost model

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Table A-1. Detailed Input Parameters for Quincy Center Intermodal Station Benefit Cost Model (Years 2017 – 2048)

		Calender Year	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
Forecast period flag		Factor	1	1	1	1	1	1	1	1	1	1
Variable	**Source/Notes**	**Unit**										
Travel Time Savings - Bus Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016
Travel Time Savings - Intercity Rail Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	595	595	595	595	595	595	595	595	595	595
Travel Time Savings - Rail Transit Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869
Safety - Fatality	negative = increase in accidents, positive = decrease in accidents	incidents	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Safety - MAIS 3	negative = increase in accidents, positive = decrease in accidents	incidents	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Reduced Energy Use	negative = increase in energy cost, positive = decrease in energy cost	$	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520
Commuter Mobility Ben-Station improvemts	negative = decrease in Liveability, positive = increase in Liveability	$	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520
Increase in QC property values	negative = decrease in property values, positive = increase in QC property values	$	-	-	-	-	-	-	-	-	-	-
Air Rights Dev - Livability	negative = decrease in real est value, positive = increase in air right value	$	-	-	-	-	-	-	-	-	-	-
Residual Value	negative = residual value cost offset, positive = n/a	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs	negative = cost savings (n/a), positive = cost of project	2014 $	-	-	-	-	-	-	-	-	-	-

Note: Input data for PRISM benefit cost model

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Table A-1. Detailed Input Parameters for Quincy Center Intermodal Station Benefit Cost Model (Years 2017 – 2048)

		Calender Year	2047	2048	2049	2050	2051	2052	2053	2054	2055
Forecast period flag		Factor	1	1	-	-	-	-	-	-	-
Variable	**Source/Notes**	**Unit**									
Travel Time Savings - Bus Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016	6,016
Travel Time Savings - Intercity Rail Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	595	595	595	595	595	595	595	595	595
Travel Time Savings - Rail Transit Passengers	negative = increase in PHT, positive = decrease in PHT	PHT	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869	66,869
Safety - Fatality	negative = increase in accidents, positive = decrease in accidents	incidents	0.1	0.1	0	0	0	0	0	0	0
Safety - MAIS 3	negative = increase in accidents, positive = decrease in accidents	incidents	0.1	0.1	0	0	0	0	0	0	0
Reduced Energy Use	negative = increase in energy cost, positive = decrease in energy cost	$	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520
Commuter Mobility Ben-Station improvemts	negative = decrease in Liveability, positive = increase in Liveability	$	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520	451,520
Increase in QC property values	negative = decrease in property values, positive = increase in QC property values	$	-	-	-	-	-	-	-	-	-
Air Rights Dev - Livability	negative = decrease in real est value, positive = increase in air right value	$	-	-	-	-	-	-	-	-	-
Residual Value	negative = residual value cost offset, positive = n/a	2014 $	-	(37,357,312)	-	-	-	-	-	-	-
Capital Costs	negative = cost savings (n/a), positive = cost of project	2014 $	-	-	-	-	-	-	-	-	-

Note: Input data for PRISM benefit cost model

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Table A-2. Detailed Benefit and Cost Figures for Quincy Center Intermodal Station Benefit-Cost Model, Assuming 7 % discount rate (Years 2017—2048)

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Forecast period flag		Factor	1	1	1	1	1	1	1	1	1	1	1
Variable	**Source/Notes**	**Unit**											
Travel Time Savings - Bus Passengers		2014 $	-	-	60,356	57,084	53,990	51,064	48,296	45,678	43,202	40,860	38,645
Travel Time Savings - Intercity Rail Passengers		2014 $	-	-	8,686	8,215	7,770	7,349	6,950	6,574	6,217	5,880	5,562
Travel Time Savings - Rail Transit Passengers		2014 $	-	-	670,871	634,506	600,113	567,583	536,817	507,718	480,197	454,168	429,549
Safety - Fatality		2014 $	-	-	681,079	636,522	594,881	555,963	519,592	485,600	453,832	424,142	396,394
Safety - MAIS 3		2014 $	-	-	71,513	66,835	62,462	58,376	54,557	50,988	47,652	44,535	41,621
Reduced Energy Use		$	-	-	3,936	3,678	3,438	3,213	3,003	2,806	2,623	2,451	2,291
Commuter Mobility Ben-Station improvemts		$	-	-	321,927	300,867	281,184	262,789	245,597	229,530	214,514	200,480	187,365
Increase in QC property values		$	-	-	13,340,538	-	-	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	18,909,112	-	-	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-	-	-	-	-	-
Capital Costs		2014 $	23,622,224	17,690,198	-	-	-	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**-**	**-**	**34,068,019**	**1,707,708**	**1,603,837**	**1,506,336**	**1,414,811**	**1,328,893**	**1,248,237**	**1,172,516**	**1,101,427**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**-**	**-**	**34,068,019**	**35,775,727**	**37,379,564**	**38,885,900**	**40,300,712**	**41,629,605**	**42,877,842**	**44,050,357**	**45,151,784**
TOTAL LIKELY COSTS		**2014 $**	**23,622,224**	**17,690,198**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**23,622,224**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Forecast period flag		Factor	1	1	1	1	1	1	1	1	1	1	1
Variable	**Source/Notes**	**Unit**											
Travel Time Savings - Bus Passengers		2014 $	36,550	34,569	32,695	30,923	29,247	27,661	26,162	24,744	23,403	22,134	20,934
Travel Time Savings - Intercity Rail Passengers		2014 $	5,260	4,975	4,705	4,450	4,209	3,981	3,765	3,561	3,368	3,185	3,013
Travel Time Savings - Rail Transit Passengers		2014 $	406,265	384,244	363,415	343,716	325,085	307,464	290,797	275,034	260,126	246,026	232,690
Safety - Fatality		2014 $	370,462	346,226	323,576	302,407	282,624	264,134	246,854	230,705	215,612	201,507	188,324
Safety - MAIS 3		2014 $	38,898	36,354	33,975	31,753	29,675	27,734	25,920	24,224	22,639	21,158	19,774
Reduced Energy Use		$	2,141	2,001	1,870	1,747	1,633	1,526	1,426	1,333	1,246	1,164	1,088
Commuter Mobility Ben-Station improvemts		$	175,107	163,652	152,945	142,940	133,588	124,849	116,681	109,048	101,914	95,247	89,016
Increase in QC property values		$	-	-	-	-	-	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	-	-	-	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-	-	-	-	-	-
Capital Costs		2014 $	-	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**1,034,684**	**972,020**	**913,182**	**857,937**	**806,061**	**757,349**	**711,606**	**668,649**	**628,308**	**590,421**	**554,839**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**46,186,468**	**47,158,488**	**48,071,670**	**48,929,607**	**49,735,668**	**50,493,017**	**51,204,624**	**51,873,273**	**52,501,581**	**53,092,002**	**53,646,841**
TOTAL LIKELY COSTS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Table A-2. Detailed Benefit and Cost Figures for Quincy Center Intermodal Station Benefit-Cost Model, Assuming 7 % discount rate (Years 2017 – 2048)

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
Forecast period flag		Factor	1	1	1	1	1	1	1	1	-	-	-
Variable	**Source/Notes**	**Unit**											
Travel Time Savings - Bus Passengers		2014 $	19,800	18,726	17,711	16,751	15,843	14,984	14,172	13,404	-	-	-
Travel Time Savings - Intercity Rail Passengers		2014 $	2,849	2,695	2,549	2,411	2,280	2,156	2,040	1,929	-	-	-
Travel Time Savings - Rail Transit Passengers		2014 $	220,077	208,147	196,865	186,193	176,101	166,555	157,527	148,988	-	-	-
Safety - Fatality		2014 $	176,004	164,489	153,729	143,671	134,272	125,488	117,279	109,606	-	-	-
Safety - MAIS 3		2014 $	18,480	17,271	16,141	15,086	14,099	13,176	12,314	11,509	-	-	-
Reduced Energy Use		$	1,017	951	888	830	776	725	678	633	-	-	-
Commuter Mobility Ben-Station improvemts		$	83,192	77,750	72,663	67,910	63,467	59,315	55,434	51,808	-	-	-
Increase in QC property values		$	-	-	-	-	-	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	-	-	-	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-	-	-	-	-	-
Capital Costs		2014 $	-	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**521,419**	**490,030**	**460,546**	**432,852**	**406,838**	**382,400**	**359,444**	**337,877**	**-**	**-**	**-**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**54,168,260**	**54,658,289**	**55,118,835**	**55,551,687**	**55,958,525**	**56,340,925**	**56,700,369**	**57,038,246**	**57,038,246**	**57,038,246**	**57,038,246**
TOTAL LIKELY COSTS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2050	2051	2052	2053	2054	2055
Forecast period flag		Factor	-	-	-	-	-	-
Variable	**Source/Notes**	**Unit**						
Travel Time Savings - Bus Passengers		2014 $	-	-	-	-	-	-
Travel Time Savings - Intercity Rail Passengers		2014 $	-	-	-	-	-	-
Travel Time Savings - Rail Transit Passengers		2014 $	-	-	-	-	-	-
Safety - Fatality		2014 $	-	-	-	-	-	-
Safety - MAIS 3		2014 $	-	-	-	-	-	-
Reduced Energy Use		$	-	-	-	-	-	-
Commuter Mobility Ben-Station improvemts		$	-	-	-	-	-	-
Increase in QC property values		$	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-
Capital Costs		2014 $	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**57,038,246**	**57,038,246**	**57,038,246**	**57,038,246**	**57,038,246**	**57,038,246**
TOTAL LIKELY COSTS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**	**41,312,422**

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Table A-3. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017—2048)

Variable	Value	Unit	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
BENEFITS BY CATEGORY												
Likely												
Travel Time	10,783,011	2014 $	-	-	739,913	699,806	661,873	625,995	592,063	559,970	529,616	500,908
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-	-
Safety	9,773,698	2014 $	-	-	752,592	703,357	657,343	614,340	574,149	536,588	501,484	468,677
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	4,231,888	2014 $	-	-	325,863	304,545	284,621	266,001	248,599	232,336	217,136	202,931
Air Rights/Property Value -Livability	32,249,650	$	-	-	32,249,650	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-	-
Total	**57,038,246**	**2014 $**										
Travel Time	18.90%	percent										
Fuel Consumption	0.00%	percent										
Oil Imports	0.00%	percent										
Emissions	0.00%	percent										
Safety	17.14%	percent										
Vehicle O&M	0.00%	percent										
Pavement Damage	0.00%	percent										
Noise	0.00%	percent										
Sustainability-Mobility	7.42%	percent										
Air Rights/Property Value -Livability	56.54%	percent										
Health	0.00%	percent										
TOTALS												
TOTAL LIKELY BENEFITS	57,038,246	2014 $	-	-	34,068,019	1,707,708	1,603,837	1,506,336	1,414,811	1,328,893	1,248,237	1,172,516
CUMULATIVE LIKELY BENEFITS			-	-	34,068,019	35,775,727	37,379,564	38,885,900	40,300,712	41,629,605	42,877,842	44,050,357
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	41,312,422	2014 $	23,622,224	17,690,198	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	41,312,422	2014 $	23,622,224	17,690,198	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			23,622,224	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422
BC Ratios												
B/C Ratio Low	1.28	ratio										
B/C Ratio Likely	1.38	ratio										
B/C Ratio High	1.48	ratio										
Net Present Value												
Net Present Value Low	11,614,482	2014 $ disc										
Net Present Value Likely	15,725,824	2014 $ disc										
Net Present Value High	19,837,166	2014 $ disc										

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-3. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015

Variable	Value	Unit	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
BENEFITS BY CATEGORY												
Likely												
Travel Time	10,783,011	2014 $	473,756	448,076	423,788	400,816	379,089	358,541	339,106	320,724	303,339	286,897
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-	-
Safety	9,773,698	2014 $	438,016	409,360	382,580	357,551	334,160	312,299	291,868	272,774	254,929	238,251
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	4,231,888	2014 $	189,655	177,248	165,652	154,815	144,687	135,222	126,375	118,108	110,381	103,160
Air Rights/Property Value -Livability	32,249,650	$	-	-	-	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-	-
Total	**57,038,246**	**2014 $**										
Travel Time	18.90%	percent										
Fuel Consumption	0.00%	percent										
Oil Imports	0.00%	percent										
Emissions	0.00%	percent										
Safety	17.14%	percent										
Vehicle O&M	0.00%	percent										
Pavement Damage	0.00%	percent										
Noise	0.00%	percent										
Sustainability-Mobility	7.42%	percent										
Air Rights/Property Value -Livability	56.54%	percent										
Health	0.00%	percent										
TOTALS												
TOTAL LIKELY BENEFITS	57,038,246	2014 $	1,101,427	1,034,684	972,020	913,182	857,937	806,061	757,349	711,606	668,649	628,308
CUMULATIVE LIKELY BENEFITS			45,151,784	46,186,468	47,158,488	48,071,670	48,929,607	49,735,668	50,493,017	51,204,624	51,873,273	52,501,581
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	41,312,422	2014 $	-	-	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	41,312,422	2014 $	-	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422
BC Ratios												
B/C Ratio Low	1.28	ratio										
B/C Ratio Likely	1.38	ratio										
B/C Ratio High	1.48	ratio										
Net Present Value												
Net Present Value Low	11,614,482	2014 $ disc										
Net Present Value Likely	15,725,824	2014 $ disc										
Net Present Value High	19,837,166	2014 $ disc										

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-3. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015

Variable	Value	Unit	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
BENEFITS BY CATEGORY												
Likely												
Travel Time	10,783,011	2014 $	271,345	256,637	242,726	229,569	217,125	205,355	194,224	183,696	173,738	164,321
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-	-
Safety	9,773,698	2014 $	222,665	208,098	194,484	181,761	169,870	158,757	148,371	138,665	129,593	121,115
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	4,231,888	2014 $	96,411	90,104	84,209	78,700	73,552	68,740	64,243	60,040	56,112	52,441
Air Rights/Property Value -Livability	32,249,650	$	-	-	-	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-	-
Total	**57,038,246**	**2014 $**										
Travel Time	18.90%	percent										
Fuel Consumption	0.00%	percent										
Oil Imports	0.00%	percent										
Emissions	0.00%	percent										
Safety	17.14%	percent										
Vehicle O&M	0.00%	percent										
Pavement Damage	0.00%	percent										
Noise	0.00%	percent										
Sustainability-Mobility	7.42%	percent										
Air Rights/Property Value -Livability	56.54%	percent										
Health	0.00%	percent										
TOTALS												
TOTAL LIKELY BENEFITS	57,038,246	2014 $	590,421	554,839	521,419	490,030	460,546	432,852	406,838	382,400	359,444	337,877
CUMULATIVE LIKELY BENEFITS			53,092,002	53,646,841	54,168,260	54,658,289	55,118,835	55,551,687	55,958,525	56,340,925	56,700,369	57,038,246
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	41,312,422	2014 $	-	-	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	41,312,422	2014 $	-	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422
BC Ratios												
B/C Ratio Low	1.28	ratio										
B/C Ratio Likely	1.38	ratio										
B/C Ratio High	1.48	ratio										
Net Present Value												
Net Present Value Low	11,614,482	2014 $ disc										
Net Present Value Likely	15,725,824	2014 $ disc										
Net Present Value High	19,837,166	2014 $ disc										

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-3. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015

Variable	Value	Unit	2047	2048	2049	2050	2051	2052	2053	2054	2055
BENEFITS BY CATEGORY											
Likely											
Travel Time	10,783,011	2014 $	-	-	-	-	-	-	-	-	-
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-
Safety	9,773,698	2014 $	-	-	-	-	-	-	-	-	-
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	4,231,888	2014 $	-	-	-	-	-	-	-	-	-
Air Rights/Property Value -Livability	32,249,650	$	-	-	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-
Total	**57,038,246**	**2014 $**									
Travel Time	18.90%	percent									
Fuel Consumption	0.00%	percent									
Oil Imports	0.00%	percent									
Emissions	0.00%	percent									
Safety	17.14%	percent									
Vehicle O&M	0.00%	percent									
Pavement Damage	0.00%	percent									
Noise	0.00%	percent									
Sustainability-Mobility	7.42%	percent									
Air Rights/Property Value -Livability	56.54%	percent									
Health	0.00%	percent									
TOTALS											
TOTAL LIKELY BENEFITS	57,038,246	2014 $	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY BENEFITS			57,038,246	57,038,246	57,038,246	57,038,246	57,038,246	57,038,246	57,038,246	57,038,246	57,038,246
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	41,312,422	2014 $	-	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	41,312,422	2014 $	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422	41,312,422
BC Ratios											
B/C Ratio Low	1.28	ratio									
B/C Ratio Likely	1.38	ratio									
B/C Ratio High	1.48	ratio									
Net Present Value											
Net Present Value Low	11,614,482	2014 $ disc									
Net Present Value Likely	15,725,824	2014 $ disc									
Net Present Value High	19,837,166	2014 $ disc									

Note: Present values assuming 7% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-3. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015

Table A-4. Detailed Benefit and Cost Figures for Quincy Center Intermodal Station Benefit-Cost Model, Assuming 7 % discount rate (Years 2017—2048)

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Forecast period flag		Factor	1	1	1	1	1	1	1	1	1	1	1
Variable	**Source/Notes**	**Unit**											
Travel Time Savings - Bus Passengers		2014 $	-	-	73,022	71,746	70,492	69,260	68,050	66,860	65,692	64,544	63,416
Travel Time Savings - Intercity Rail Passengers		2014 $	-	-	10,509	10,325	10,145	9,967	9,793	9,622	9,454	9,289	9,126
Travel Time Savings - Rail Transit Passengers		2014 $	-	-	811,656	797,472	783,535	769,843	756,389	743,171	730,183	717,423	704,885
Safety - Fatality		2014 $	-	-	824,006	800,006	776,704	754,082	732,118	710,795	690,092	669,992	650,478
Safety - MAIS 3		2014 $	-	-	86,521	84,001	81,554	79,179	76,872	74,633	72,460	70,349	68,300
Reduced Energy Use		$	-	-	4,762	4,623	4,488	4,358	4,231	4,107	3,988	3,872	3,759
Commuter Mobility Ben-Station improvemts		$	-	-	389,485	378,141	367,127	356,434	346,052	335,973	326,187	316,687	307,463
Increase in QC property values		$	-	-	16,140,096	-	-	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	22,877,255	-	-	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-	-	-	-	-	-
Capital Costs		2014 $	26,482,590	20,602,451	-	-	-	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**-**	**-**	**41,217,310**	**2,146,313**	**2,094,046**	**2,043,122**	**1,993,506**	**1,945,162**	**1,898,056**	**1,852,155**	**1,807,427**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**-**	**-**	**41,217,310**	**43,363,622**	**45,457,668**	**47,500,790**	**49,494,296**	**51,439,458**	**53,337,513**	**55,189,669**	**56,997,096**
TOTAL LIKELY COSTS		**2014 $**	**26,482,590**	**20,602,451**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**26,482,590**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Forecast period flag		Factor	1	1	1	1	1	1	1	1	1	1	1
Variable	**Source/Notes**	**Unit**											
Travel Time Savings - Bus Passengers		2014 $	62,308	61,219	60,149	59,098	58,065	57,050	56,053	55,074	54,111	53,166	52,237
Travel Time Savings - Intercity Rail Passengers		2014 $	8,967	8,810	8,656	8,505	8,356	8,210	8,067	7,926	7,787	7,651	7,518
Travel Time Savings - Rail Transit Passengers		2014 $	692,567	680,464	668,572	656,888	645,409	634,130	623,048	612,160	601,462	590,951	580,623
Safety - Fatality		2014 $	631,532	613,138	595,279	577,941	561,108	544,765	528,898	513,493	498,537	484,017	469,919
Safety - MAIS 3		2014 $	66,311	64,379	62,504	60,684	58,916	57,200	55,534	53,917	52,346	50,822	49,341
Reduced Energy Use		$	3,649	3,543	3,440	3,340	3,242	3,148	3,056	2,967	2,881	2,797	2,715
Commuter Mobility Ben-Station improvemts		$	298,508	289,813	281,372	273,177	265,220	257,495	249,996	242,714	235,645	228,781	222,118
Increase in QC property values		$	-	-	-	-	-	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	-	-	-	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-	-	-	-	-	-
Capital Costs		2014 $	-	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**1,763,841**	**1,721,366**	**1,679,973**	**1,639,633**	**1,600,317**	**1,561,999**	**1,524,652**	**1,488,251**	**1,452,769**	**1,418,184**	**1,384,471**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**58,760,937**	**60,482,303**	**62,162,277**	**63,801,909**	**65,402,226**	**66,964,225**	**68,488,877**	**69,977,128**	**71,429,897**	**72,848,082**	**74,232,553**
TOTAL LIKELY COSTS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
Forecast period flag		Factor	1	1	1	1	1	1	1	1	-	-	-
Variable	**Source/Notes**	**Unit**											
Travel Time Savings - Bus Passengers		2014 $	51,324	50,427	49,546	48,680	47,829	46,993	46,172	45,365	-	-	-
Travel Time Savings - Intercity Rail Passengers		2014 $	7,386	7,257	7,130	7,006	6,883	6,763	6,645	6,529	-	-	-
Travel Time Savings - Rail Transit Passengers		2014 $	570,477	560,507	550,712	541,088	531,632	522,341	513,213	504,244	-	-	-
Safety - Fatality		2014 $	456,232	442,944	430,042	417,517	405,356	393,550	382,087	370,958	-	-	-
Safety - MAIS 3		2014 $	47,904	46,509	45,154	43,839	42,562	41,323	40,119	38,951	-	-	-
Reduced Energy Use		$	2,636	2,560	2,485	2,413	2,342	2,274	2,208	2,144	-	-	-
Commuter Mobility Ben-Station improvemts		$	215,648	209,367	203,269	197,349	191,601	186,020	180,602	175,342	-	-	-
Increase in QC property values		$	-	-	-	-	-	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	-	-	-	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-	-	-	-	-	-
Capital Costs		2014 $	-	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**1,351,608**	**1,319,571**	**1,288,339**	**1,257,891**	**1,228,206**	**1,199,264**	**1,171,046**	**1,143,532**	**-**	**-**	**-**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**75,584,161**	**76,903,731**	**78,192,070**	**79,449,961**	**80,678,167**	**81,877,431**	**83,048,477**	**84,192,009**	**84,192,009**	**84,192,009**	**84,192,009**
TOTAL LIKELY COSTS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Base Year (for discounting, 2014 = 2014 $s)	2014	Calender Year	2050	2051	2052	2053	2054	2055
Forecast period flag		Factor	-	-	-	-	-	-
Variable	**Source/Notes**	**Unit**						
Travel Time Savings - Bus Passengers		2014 $	-	-	-	-	-	-
Travel Time Savings - Intercity Rail Passengers		2014 $	-	-	-	-	-	-
Travel Time Savings - Rail Transit Passengers		2014 $	-	-	-	-	-	-
Safety - Fatality		2014 $	-	-	-	-	-	-
Safety - MAIS 3		2014 $	-	-	-	-	-	-
Reduced Energy Use		$	-	-	-	-	-	-
Commuter Mobility Ben-Station improvemts		$	-	-	-	-	-	-
Increase in QC property values		$	-	-	-	-	-	-
Air Rights Dev - Livability		$	-	-	-	-	-	-
Residual Value		2014 $	-	-	-	-	-	-
Capital Costs		2014 $	-	-	-	-	-	-
TOTAL LIKELY BENEFITS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY BENEFITS		**2014 $**	**84,192,009**	**84,192,009**	**84,192,009**	**84,192,009**	**84,192,009**	**84,192,009**
TOTAL LIKELY COSTS		**2014 $**	**-**	**-**	**-**	**-**	**-**	**-**
CUMULATIVE LIKELY COSTS		**2014 $**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**	**47,085,041**

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis
Quincy, Massachusetts

Table A-4. Detailed Benefit and Cost Figures for Quincy Center Intermodal Station Benefit-Cost Model, Assuming 7 % discount rate (Years 2017 – 2048)

Table A-5. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017—2048)

Variable	Value	Unit	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
BENEFITS BY CATEGORY												
Likely												
Travel Time	19,957,273	2014 $	-	-	895,187	879,543	864,172	849,070	834,232	819,653	805,329	791,255
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-	-
Safety	17,597,773	2014 $	-	-	910,526	884,006	858,258	833,261	808,991	785,428	762,552	740,341
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	7,619,614	2014 $	-	-	394,246	382,764	371,615	360,791	350,283	340,080	330,175	320,558
Air Rights/Property Value -Livability	39,017,350	$	-	-	39,017,350	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-	-
Total	**84,192,009**	**2014 $**										
Travel Time	23.70%	percent										
Fuel Consumption	0.00%	percent										
Oil Imports	0.00%	percent										
Emissions	0.00%	percent										
Safety	20.90%	percent										
Vehicle O&M	0.00%	percent										
Pavement Damage	0.00%	percent										
Noise	0.00%	percent										
Sustainability-Mobility	9.05%	percent										
Air Rights/Property Value -Livability	46.34%	percent										
Health	0.00%	percent										
TOTALS												
TOTAL LIKELY BENEFITS	84,192,009	2014 $	-	-	41,217,310	2,146,313	2,094,046	2,043,122	1,993,506	1,945,162	1,898,056	1,852,155
CUMULATIVE LIKELY BENEFITS			-	-	41,217,310	43,363,622	45,457,668	47,500,790	49,494,296	51,439,458	53,337,513	55,189,669
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	47,085,041	2014 $	26,482,590	20,602,451	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	47,085,041	2014 $	26,482,590	20,602,451	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			26,482,590	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041
BC Ratios												
B/C Ratio Low	1.63	ratio										
B/C Ratio Likely	1.79	ratio										
B/C Ratio High	1.95	ratio										
Net Present Value												
Net Present Value Low	29,595,959	2014 $ disc										
Net Present Value Likely	37,106,968	2014 $ disc										
Net Present Value High	44,617,977	2014 $ disc										

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-5. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015

Variable	Value	Unit	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
BENEFITS BY CATEGORY												
Likely												
Travel Time	19,957,273	2014 $	777,428	763,842	750,493	737,377	724,491	711,830	699,390	687,168	675,159	663,360
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-	-
Safety	17,597,773	2014 $	718,778	697,843	677,517	657,784	638,625	620,024	601,965	584,432	567,410	550,883
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	7,619,614	2014 $	311,222	302,157	293,356	284,812	276,517	268,463	260,643	253,052	245,681	238,526
Air Rights/Property Value -Livability	39,017,350	$	-	-	-	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-	-
Total	**84,192,009**	**2014 $**										
Travel Time	23.70%	percent										
Fuel Consumption	0.00%	percent										
Oil Imports	0.00%	percent										
Emissions	0.00%	percent										
Safety	20.90%	percent										
Vehicle O&M	0.00%	percent										
Pavement Damage	0.00%	percent										
Noise	0.00%	percent										
Sustainability-Mobility	9.05%	percent										
Air Rights/Property Value -Livability	46.34%	percent										
Health	0.00%	percent										
TOTALS												
TOTAL LIKELY BENEFITS	84,192,009	2014 $	1,807,427	1,763,841	1,721,366	1,679,973	1,639,633	1,600,317	1,561,999	1,524,652	1,488,251	1,452,769
CUMULATIVE LIKELY BENEFITS			56,997,096	58,760,937	60,482,303	62,162,277	63,801,909	65,402,226	66,964,225	68,488,877	69,977,128	71,429,897
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	47,085,041	2014 $	-	-	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	47,085,041	2014 $	-	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041
BC Ratios												
B/C Ratio Low	1.63	ratio										
B/C Ratio Likely	1.79	ratio										
B/C Ratio High	1.95	ratio										
Net Present Value												
Net Present Value Low	29,595,959	2014 $ disc										
Net Present Value Likely	37,106,968	2014 $ disc										
Net Present Value High	44,617,977	2014 $ disc										

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-5. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015

Variable	Value	Unit	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
BENEFITS BY CATEGORY												
Likely												
Travel Time	19,957,273	2014 $	651,768	640,378	629,187	618,191	607,388	596,773	586,344	576,097	566,030	556,138
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-	-
Safety	17,597,773	2014 $	534,838	519,260	504,136	489,453	475,197	461,356	447,919	434,872	422,206	409,909
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	7,619,614	2014 $	231,578	224,833	218,285	211,927	205,754	199,761	193,943	188,294	182,810	177,485
Air Rights/Property Value -Livability	39,017,350	$	-	-	-	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-	-
Total	**84,192,009**	**2014 $**										
Travel Time	23.70%	percent										
Fuel Consumption	0.00%	percent										
Oil Imports	0.00%	percent										
Emissions	0.00%	percent										
Safety	20.90%	percent										
Vehicle O&M	0.00%	percent										
Pavement Damage	0.00%	percent										
Noise	0.00%	percent										
Sustainability-Mobility	9.05%	percent										
Air Rights/Property Value -Livability	46.34%	percent										
Health	0.00%	percent										
TOTALS												
TOTAL LIKELY BENEFITS	84,192,009	2014 $	1,418,184	1,384,471	1,351,608	1,319,571	1,288,339	1,257,891	1,228,206	1,199,264	1,171,046	1,143,532
CUMULATIVE LIKELY BENEFITS			72,848,082	74,232,553	75,584,161	76,903,731	78,192,070	79,449,961	80,678,167	81,877,431	83,048,477	84,192,009
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	47,085,041	2014 $	-	-	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	47,085,041	2014 $	-	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041
BC Ratios												
B/C Ratio Low	1.63	ratio										
B/C Ratio Likely	1.79	ratio										
B/C Ratio High	1.95	ratio										
Net Present Value												
Net Present Value Low	29,595,959	2014 $ disc										
Net Present Value Likely	37,106,968	2014 $ disc										
Net Present Value High	44,617,977	2014 $ disc										

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-5. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015

Variable	Value	Unit	2047	2048	2049	2050	2051	2052	2053	2054	2055
BENEFITS BY CATEGORY											
Likely											
Travel Time	19,957,273	2014 $	-	-	-	-	-	-	-	-	-
Fuel Consumption	-	2014 $	-	-	-	-	-	-	-	-	-
Oil Imports	-	2014 $	-	-	-	-	-	-	-	-	-
Emissions	-	2014 $	-	-	-	-	-	-	-	-	-
Safety	17,597,773	2014 $	-	-	-	-	-	-	-	-	-
Vehicle O&M	-	2014 $	-	-	-	-	-	-	-	-	-
Pavement Damage	-	2014 $	-	-	-	-	-	-	-	-	-
Noise	-	2014 $	-	-	-	-	-	-	-	-	-
Sustainability-Mobility	7,619,614	2014 $	-	-	-	-	-	-	-	-	-
Air Rights/Property Value -Livability	39,017,350	$	-	-	-	-	-	-	-	-	-
Health	-	2014 $	-	-	-	-	-	-	-	-	-
Total	**84,192,009**	**2014 $**									
Travel Time	23.70%	percent									
Fuel Consumption	0.00%	percent									
Oil Imports	0.00%	percent									
Emissions	0.00%	percent									
Safety	20.90%	percent									
Vehicle O&M	0.00%	percent									
Pavement Damage	0.00%	percent									
Noise	0.00%	percent									
Sustainability-Mobility	9.05%	percent									
Air Rights/Property Value -Livability	46.34%	percent									
Health	0.00%	percent									
TOTALS											
TOTAL LIKELY BENEFITS	84,192,009	2014 $	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY BENEFITS			84,192,009	84,192,009	84,192,009	84,192,009	84,192,009	84,192,009	84,192,009	84,192,009	84,192,009
Residual Value - Likely	-	2014 $	-	-	-	-	-	-	-	-	-
Capital Costs - Likely	47,085,041	2014 $	-	-	-	-	-	-	-	-	-
O&M Costs Total - Likely	-	2014 $	-	-	-	-	-	-	-	-	-
Rehabilitation Costs - Likely	-	2014 $	-	-	-	-	-	-	-	-	-
TOTAL LIKELY COSTS	47,085,041	2014 $	-	-	-	-	-	-	-	-	-
CUMULATIVE LIKELY COSTS			47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041	47,085,041
BC Ratios											
B/C Ratio Low	1.63	ratio									
B/C Ratio Likely	1.79	ratio									
B/C Ratio High	1.95	ratio									
Net Present Value											
Net Present Value Low	29,595,959	2014 $ disc									
Net Present Value Likely	37,106,968	2014 $ disc									
Net Present Value High	44,617,977	2014 $ disc									

Note: Present values assuming 3% discount rate

Quincy Center Intermodal Station Benefit-Cost Analysis

Quincy, Massachusetts

Table A-5. Detailed Summary of Quincy Center Intermodal Station Benefits by Category, Total Benefits and Costs, BC Ratios, and Net Present Values, Assuming 7 % Discount Rate (Years 2017 – 2048)

Source, Parsons Brinckerhoff, 2015